ANALYSIS OF THE EFFECTIVENESS AND FUNCTIONAL OUT COME OF KLISIC PROCEDURE IN NEGLECTED DEVELOPMENTAL DYSPLASIA OF HIP IN CHILDREN MORE THAN THREE YEARS OLD

Dissertation submitted for

M.S. DEGREE EXAMINATION

BRANCH II ORTHOPAEDIC SURGERY

DEPARTMENT OF ORTHOPAEDIC SURGERY

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SEPTEMBER – 2006

ACKNOWLEDGEMENT

I express my thanks and gratitude to our respected Dean **Prof. Dr. KALAVATHY PONNERIVAN B.Sc., M.D., (Bio),** Dean, Madras Medical College, Chennai – 3 for having given permission for conducting this study and utilize the clinical materials of this hospital.

I have great pleasure in thanking my teacher **Prof. MAYILVAHANAN NATRAJAN, M.S.Ortho., M.Ch., Orth (LiverPool) PhD., D.Sc.,** Professor and Head of the Department of Orthopedic Surgery, Madras Medical College for permitting me to use the clinical materials and for his valuable advice and guidance.

I have great pleasure in thanking my teacher and guide **Prof. R.H. GOVARDHAN M.S.Ortho, D.Ortho.,** for permitting me to use the clinical materials and for his valuable advice and encouragement in preparing this dissertation.

My sincere thanks and gratitude to **Prof. K. ANBAZHAGAN M.S.Ortho., D.Ortho.,** for constant advice and guidance.

My sincere thanks and gratitude to **Prof. V. THULASI RAMAN M.S.Ortho., D.Ortho.,** for his constant advice and guidance

I am very much grateful to Rtd., **Prof. R. DHANAPAL, M.S.Ortho., D.Ortho.,** for his valuable support and guidance that he has provided me for this study.

My special thanks to **Dr. B. PASUPATHY,** who had been my guide for this study and for his constant guidance and advice.

I sincerely thank **Dr. NALLI R. UVARAJ, R. SELVARAJ, Dr. V, MAZHAVAN, Dr. R. SUBBIAH, Dr. RAMESH PANDIAN, Dr. ANTONY VIMALRAJ, Dr. S. KARUNAKARAN AND Dr. PAULRAJ,** Assistant Professors of this Department for their suggestions and help during my study.

I sincerely thank **Prof. MANGAIYARKARASI SENGUTUVAN M.D.Paed., Dch.,** Director of Institute of Child Health for using the clinical materials from Institute of Child Health.

I am grateful to my post graduate colleagues and other staff members of the Department of Orthopedics who helped me in all possible ways in this project.

Last but not the least, my sincere thanks to all our patients and their parents for their co-operations in conducting this study.

CERTIFICATE

This is to certify that this dissertation entitled **ANALYSIS OF THE EFFECTIVENESS AND FUNCTIONAL OUT COME OF KLISIC PROCEDURE IN NEGLECTED DEVELOPMENTAL DYSPLASIA OF HIP IN CHILDREN MORE THAN THREE YEARS OLD** submitted by **Dr. K.P. MANIMARAN** appearing for Part – II M.S. Branch – II Orthopaedic Surgery Degree examination in September 2006 is a bonafide record of work done by him under my direct guidance and supervision in partial fulfillment of regulations of the Tamil Nadu Dr. M.G.R. Medical University, Chennai.

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CONTENTS

INTRODUCTION

Developmental dysplasia of hip (DDH) is a spectrum of disorders of the developing hip that present in different forms at different ages. This developmental disorder of hip evolves over a period of time during childhood. The structures that make-up the hip are normal during embryogenesis and it gradually become abnormal for a variety of reasons mainly foetal position and presentation at birth. The older term congenital dislocation of the hip has gradually been replaced by developmental dysplasia. Klisic in 1989 recommended, the use of the term "developmental displasia of hip" to indicate a dynamic disorder potentially capable of getting better or worse as the child grows.[9] The term developmental dysplasia is used to denote both dislocation and dysplasia of hip.

The syndrome in the newborn consists of the instability of hip, such that the femoral head can be displaced partially (subluxated) or fully (dislocated) from the acetabulum. Gradually the femoral head becomes fully dislocated and cannot be reduced by changing the position of the hip. The syndrome may manifest later in the childhood or adolescence as a dislocated hip, and with a poorly developed acetabulum.

As the child becomes older more secondary deformities develop which can be grouped on 3 major pathological entities:

1. Acetabular dysplasias
2. Subluxation or dislocation of femoral head with anteversion deformities.
3. Secondary soft tissue contractures.

These changes pose a great challenge to the treating orthopaedic surgeons in the management of neglected developmental dysplasia of hip.

AIM OF THE STUDY

The aim of this study is to analyse the effectiveness and functional outcome in neglected developmental dysplasia of hip at three year and above, by one stage correction procedure (Klisic) that consists of.

- Open reduction of the hip joint
- Capsulorrhaphy
- Femoral shortening and varization
- Pelvic osteotomy

HISTORICAL REVIEW

1832 - Guillaume Dupuytren described the condition of dislocation of the hip at birth and termed as "Original or congenital dislocation of hip[3].

1900 - Adolph Lorenz ,Professor of Surgery at the University of Vienna at the turn of century travel extensively and demonstrated his vigorous Technique of closed reduction of hip[10].

1927 - Putti pointed out the advantages of early treatment of hip dislocations and claimed perfect results in more than 90 percent of hips of less than one year old.

1935 - Ortolani, published an article entitled A very little known sign and its importance in the early diagnosis of congenital hip dislocation[14].

1946 - The Italian government opened a center for the diagnosis, prophylaxis and treatment of congenital displasia of the hip[14].

1961 - Salter RB pointed out innominate osteotomy for development dysplasia of hip is essential for acetabular dysplasia[20].

1965 - Paul. A. Pemperton described a peri capsular osteotomy for the treatment of congenital subluxation and dislocation of hip[16].

1969 - Dega described a transiliac osteotomy to treat residual acetabular dysplasia secondary to congenital hip dysplasia or dislocation[17].

1976 - Predrag klisic described the combined procedure of open reduction, shortening of the femur and pelvic osteotomy in treatment of congenital dislocation of hip in older children[7].

1989 - Robert D.Galpin started treating congenital dislocation of hip by one stage treatment by performing open reduction, femoral shortening and pelvic osteotomy[5].

1996 - Rachid K. Haider performed open reduction, femoral shortening and salter innominate osteotomy for congenital dislocation of hip[18].

2003 - R.R. Rajendra performed one stage open reduction with salter innominate osteotomy and corrective osteotomy for the treatment of congenital dysplasia of the hip.[19]

ETIOPATHOGENESIS OF DEVELOPMENTAL DYSPLASIA OF HIP

There is no single cause for developmental dysplasia of hip but number of predisposing factors have been identified. These factors include.

- Ligamentous Laxity
- Prenatal Positioning
- Post natal positioning
- Racial predilection

The Etiology of developmental dysplasia of hip is of multifactorial and it is influenced by hormonal and genetic elements.

Ligamentous Laxity

It is related to developmental dysplasia of hip in several ways. The condition is associated with developmental dysplasia of hip when laxity is a familial triat. The newborn's response to maternal relaxin hormones may explain the higher incidence of developmental dysplasia of hip in females. The hormones which produce ligamentous laxity for the expansion of the maternal pelvis cross the placenta and induce laxity in the infant. This effect is

much stronger in female infant than in males. In Coleman's study of Navojo families hip dysplasia in one family member increased the risk for other family members five time.[2]

Wynne – Davies proposed that hereditable ligamentous laxity was one of the major mechanisms for the inheritance of developmental dysplasia of hip.[24] She believed this was an autosomal dominant characteristic with incomplete penetrance. The risk of developmental dysplasia of hip is 34 percent in identical twins but only 3 percent in fraternal twins. This also suggest a genetic influence in the developmental dysplasia of hip.[6]

Prenatal Positioning

It is strongly associated with developmental dysplasia of hip babies with breech presentation are at higher risk for developmental dysplasia of hip. Although only 2 to 3% of babies are born in breech presentation.[22] Muller and Seddon found that 16% of babies with developmental dysplasia of hip were born in breech presentation.[13] The breech effect is most notable when the knees are extended. The hip is affected by intrauterine position and delivery by caesarean section does not alter the likelihood of hip dislocation. There is increased incidence of other postural abnormalities like torticollis, and metatarsus adductus in children

with developmental dysplasia of hip. The incidence is higher in first born children and in pregnancies complicated by oligohydramnios[1].

Post natal Positioning

It is an another factor associated with developmental dysplasia of hip. People who wrap their newborn babies in a hip extended position such as native Americans who use cradleboards have much higher incidence of developmental dysplasia of hip than other population. The mechanism of action is believed to be the placement of the hips in full extension, against the normal neonatal hip flexion posture. People who usually carry their babies astride the hip or in a wrap that flexes and abducts the hip have a lower incidence of developmental dysplasia of hip.

Racial Predilection

Racial predilection apparently plays a role, since certain ethnic groups seem to be predisposed to developmental dysplasia of hip while the other appear somewhat immune.

Blacks and Asian have relatively low incidence of developmental dysplasia of hip while Caucasians and native Americans have the higher incidence of developmental dysplasia of hip. The incidence of hip dislocation is 4.9 per 1000 in blacks

compared with 15.5 per 1000 in Caucasians[1]. The incidence of developmental dysplasia of hip in India is 1.5 per 1000.

Primary failure of the acetabular development has been proposed as a cause of developmental dysplasia of hip. Morville showed that the neonatal acetabulum was shallow and that full coverage of the femoral head did not occur until the child was about three years old[12].

ANATOMY OF NEGLECTED DEVELOPMENTAL DYSPLASIA OF HIP

Developmental dysplasia of hip is a gradually progressive disorder associated with distinct anatomical changes many of which are initially reversible. It is a malformation of anatomic structure that have developed normally during the embryologic period. As the child grows secondary changes in the pelvis occurs which are not reversible.

At birth the affected hip will spontaneously slide into and out of the acetabulum. For this to occur, the posterior superior rim of the acetabulum has to have lost its sharp margin and become flattered and thickened on the area over which the femoral head slide. As the head rides in and out of the socket, a ridge of thickened artiular cartilage arises along the posterior superior acetabular wall.

If the hip remains dislocated out of the socket permanently, many secondary anatomic changes will take plate gradually.

The anatomy of neglected developmental dysplasia of hip is discussed in two main headings.

- Changes in bones

- Changes in soft tissues

Changes in bones

The acetabulum

The acetabulum is shallower than normal. At birth the only error apparent is a gap or groove at its posterosuperior part. Later its rounded shape disappears. The acetabular cavity is converted into a triangular depression with its base in front and below, and its apex above and behind.

The acetabulum instead of containing the head of femur occupied by an over growth of fibrocartilage, the remains of ligamentum teres and covered by the anterior portion of the capsule which is usually adherent to the floor.

Above the acetabulum there is a depression on the dorsal ilium. Lined with periosteum, in which the head of the femur rests in securely. A fold of the capsule intervening between the ilium and the head. In developmental dysplasia of hip the acetabular roof was well developed but the posterior wall was made up of mainly a fibrous labrum and a little cartilage.

Head of the femur

The femoral head is at first normal. The ossification is often delayed and there is a marked discrepancy between he size of the cartilage head and the reduced acetabulam. Later the head of the femur becomes flattened on its medial and posterior aspects. If the head rests on the dorsal ilium it becomes butter shaped otherwise it is conical. The cartilage portion usually large in comparison with the acetabulum.

The neck of femur

There is marked shortening of the neck of femur which increased the shortening of the limb. The neck is anteverted. The normal anteversion is 12° and in developmental dysplasia of hip it may be upto 90°. The neck appears to project straight forward from the shaft. As a result of this anatomical change in the neck of femur when the dislocation is reduced, the limb is rotated internally and the patella looks directly medially.

Muscle imbalance also significantly affect the upper femur. Excessive adductor pull or inadequate abductor muscle function will result in a valgus deformity of the upper femur[15, 21].

The Pelvis

When there is a bilateral dislocation the pelvis is tilted forwards and the normal lumbosacral lordosis increased. The whole innominate bone may be small and atrophied and lies more vertically than normal. So that the iliac crests are approximated and the ischia more widely separated.

In unilateral dislocation the corresponding pelvic bone is under developed. The pelvis has a lateral inclination while the shape of the inlet is obliquely ovoid.

Change in the soft tissues

The Capsule

The hip capsule is hourglass in shape. One cavity containing the head the other covering the acetabulam. The constriction between them is produced by the Iliopsoas tendon which crosses the capsule at this level. The ligamentum teres passes through the narrow isthumus.

The lower part of the capsule is stretched across the entrance to the acetabulam. The capsule becomes a suspensury ligament for the pelvis and underwent hypertrophy particularly at its anterior and lower portions. The ligamentum teres is usually attenuated or

may be absent. In certain cases it may be hypertrophied and it may resist reduction.

The Muscles

There are considerable alteration in the muscles of the pelvis and the femur. This is one of the cause of failure to reduce the head into the acetabulum.

The pelvi femoral Group

The adductors, hamstrings gracilis, sartorius tensor fascia latae, pectinius and rectus femorrs are the pelvi femoral group of muscle. As the femur migrates upwards these muscles becomes shortened and will obstruct the reduction of femoral head.

Pelvitrochanteric Group

The obturators, quadratus femoris and psoas tendon are belong to this group. They are stretched and elongated and are functionally in competent. The contracted Ilopsoas tendon acts as a fulcrum to produce dislocation or subluxation during adduction.

The Gluteal Muscles

The dislocated head leads to an alteration in the axis of the gluteal muscles movement so their power is considerably diminished.

CLINICAL EVALUATION

In neglected Developmental dysplasia of hip the affected hip joint is unstable, the trochanter is elevated and ascends up whenever the body weight is transmitted through the affected side. The affected hip appears shorter than the normal side. The child will have a toe walk on the affected side.

Gait

In a bilateral dislocation of hip there will be a waddling or sailor's gait. It consists of an inclination towards the weight bearing side. In unilateral dislocation of hip the child lurches towards the affected side. This is due to the diminished functional ability of the gluteal muscles, shortening of the neck of femur and dislocation of the head. This results in lordosis and abnormal lateral mobility of the lumbar spine.

Lordosis

In developmental dysplasia of hip there will be lordosis and abnormal lateral mobilization of the lumbar spine. This is often associated with bilateral dislocation of hip but to a lesser degree in unilateral dislocation of hip. Corresponding protrusion of the

abdomen is also present. The lordosis is secondary to the hip flexion contracture.

Deformity

There is marked shortening of the affected side and the shortening is found to be above the level of greater trochanter. In bilateral cases legs appear too short for the body. The perineal space is broadened. The trochanters are prominent and the buttocks are broad and flat.

Vascular sign of Narath

It is usually positive on the side of dislocation due to the displacement of fermoral head which normally supports the femoral artery.

Movements

There will be limitation of abduction and lateral rotation. In early cases, a distinct telescoping cab be elicited when the femur is moved up and down in its long axis. This is due to the upward and downward movement of the femoral head on the dorsal ilium.

Measurement

In unilateral developmental dysplasia the affected leg will be shorter than the normal side. If it is a bilateral development dysplasia of hip also, there will be some difference between the two lower limbs and the shortening is above the level of the trochanter.

Trendelenburg's Sign

It is elicted by asking the child to weight bear on one foot and on the other. When the child stands on the sound side the buttock of the opposite side rises slightly because of the gluteal muscle contraction. When the child stands on the dislocated side the opposite buttock drops, because the gluteal muscle is relatively inefficient and therefore the pelvis cannot be raised.

The amount of drop depends on the degree of displacement and continues until the femur and the side wall of pelvis of the side on which the child is standing are brought into contact. The Trendelenburg test is most pathognomic of congenital dislocation of hip. But occurs whenever the action of the gluteal medius is interfered.

Galeazzi Sign

In neglected developmental dysplasia of hip, the femur on the affected side has ridden proximally. Flexing the both hips with the pelvis flat on the table permits to estimate the height of the knees. This is called Galeazzi sign.

In developmental dysplasia of hip trendelenburg is positive due to

1. The axis of the gluteal medius which is normally vertical is altered to horizondal direction.
2. Due to the instability of the fulcrum (dislocation of the head of femur).

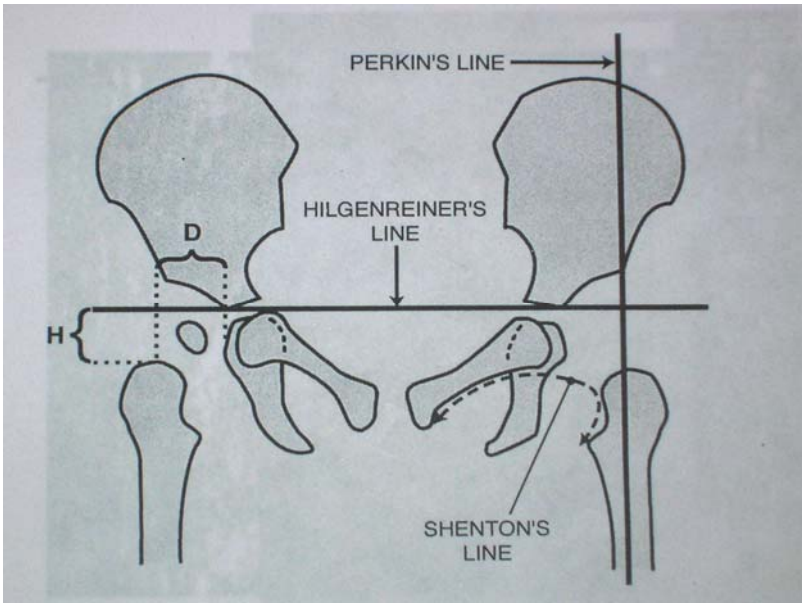
RADIOLOGICAL INVESTIGATIONS

In neglected developmental dysplasia of hip, plain radiograph of the pelvis will usually demonstrate a frankly dislocated hip.

Several classic lines are helpful in evaluating the hip radiograph in developmental dysplasia of hip.

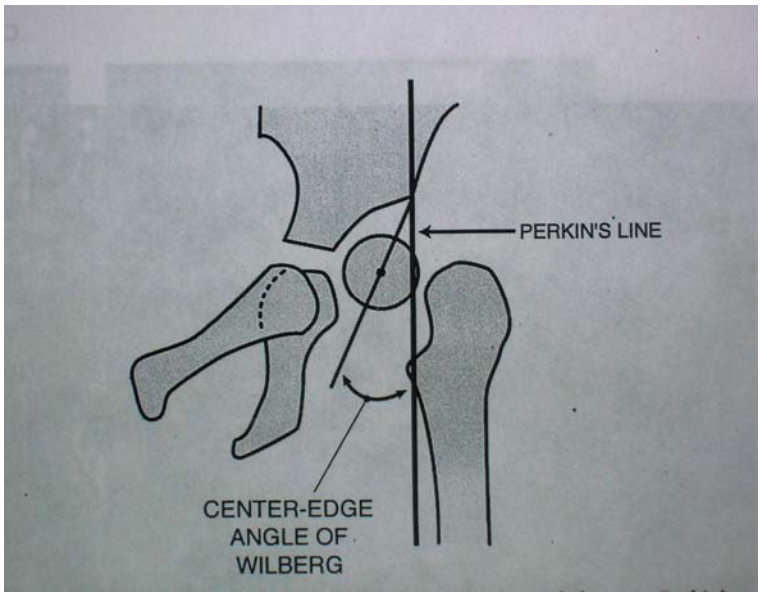
1. Hilgenreiner's Line

This is a horizondal line through the triradiate cartilages.



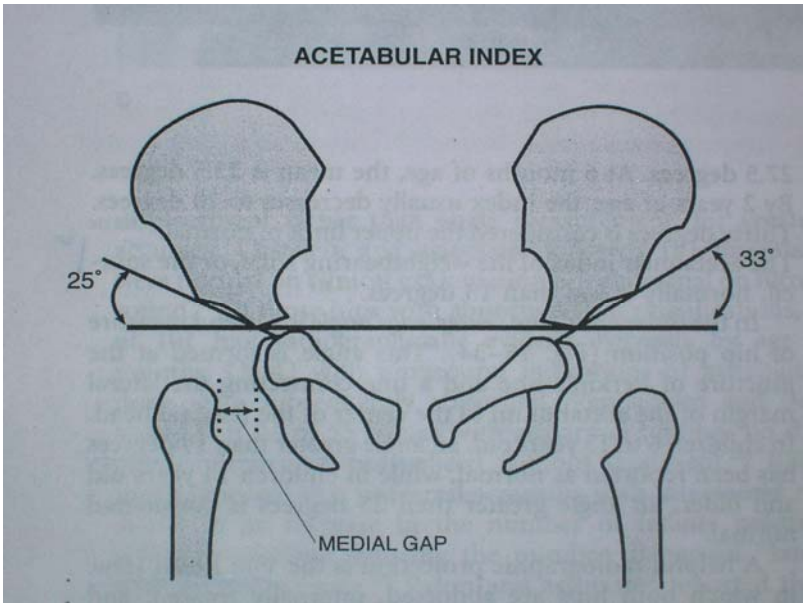
2. Perkin's Line

This is the line drawn at the lateral margin of the acetabulum and it is perpendicular to the hilgenreiner's line.



3. Acetabular Index

It is an angle formed by the juncture of hilgenreiner's line and a line drawn along the acetabular surface. Thirty degree is considered to be the upper limit of normal.



Center Edge Angle

This angle is formed a the junction of perkin's line and a line connecting the lateral margin of the acetabulam to the centre of the femoral head. In children of 6 – 13 year old an angle greater than 19 degree is considered normal. In children more than 14 yrs old 25 degree in considered normal.

Von Rosen View

The both hips are abducted internally rotated and extended. In the normal hip the imaginary line from the femoral shaft intersects the acetabulum, when the hip is dislocated the line crosses above the acetabulum.

Acetabular Tear drop

It is seen on in anteroposterior radiograph of the pelvis. It is directed from the wall of the acetabulum laterally, the wall of the lesser pelvis medially and a curved line inferiorly and is formed by acetabular notch. When the hip is dislocated or subluxated, the acetabular portion of the tear drop loses it s convexity and the tear drop is wider from superior to inferior. The 'V' shaped tear drop being associated with dysplastic hips and a poor outcome.

Arthrography

In the normal hip the free portion of the labrum is easily seen as a sharp “thorn” overlying the femoral head. A recess of joint capsule overlies the thorn. In child with developmental dysplasia of hip is in dislocated position. The acetabular edge is seen and the capsule is enlarged as it extends over the femoral need. The capsule is constricted at its importation into an hourglass shape by the iliopsoas tendon.

TREATMENT METHODOLOGY

All the patients were treated with one stage correction procedure which was described by predrag klisic. The klisic's procedure consists of

- Open reduction
- Capsulorrhaphy
- Femoral Shortening, derotation and varization
- Pelvic osteotomy (Salter or Dega osteotomy)

In our study none of the patients were put in Skeletal traction in the fear of avascular necrosis. The amount of the shortening femur is calculated preoperatively from the upper pole of femoral head to the superior part of the roof of acetabulum In our study we have done 6 Salter Osteotomies and 6 Dega Osteotomies the shortening.

In one case secondary valgus deformity of the knee due to the dislocated hip was corrected by ilizarov fixator prior to the Klisic procedure. In one case we observed avascular necrosis of dislocated femoral head pre operatively.

Post Op Protocol

- Drain removal, on 2nd day
- Antibiotics upto 3rd day
- Suture removal, on 10 to 12th day
- Hip spica immobilization for 6 to 8 weeks
- After 8th week mobilization in bed
- Weight bearing and walking as tolerated.

SURGICAL PROCEDURE

This Kilsic procedure is done under general anesthesia with caudal block. Patient is put in supine position with a sand bag under the affected hip.

Open Reduction

We followed the anterior or iliofemoral approach. The bikini incision is made from the anterior superior iliac spine to the lateral aspects of the femur. The superficial plane is between sartorius and tensor fascia lata. The Deep plane is between rectus femoris and gluteus medius. The reflected part of the rectus femoris is erased from capsule. The capsule is incised and the pseudo acetabulum is identified. The ligamentum teres is traced and the true acetabulum identified. The iliopsoas tendon identified and cut to facilitate reduction of the hip joint.

Femoral Shortening

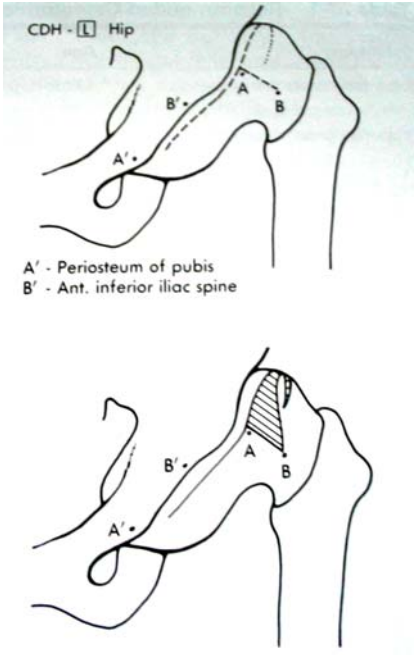
Through the lateral approach the femur is exposed by erasing the vastuslateralis from the lateral intermuscular septum. Femoral osteotomy is performed with the help of giglee saw to facilitate reduction of the femoral head to the hip joint. The osteotomy is performed at the level of the lesser trochanter. The length of the

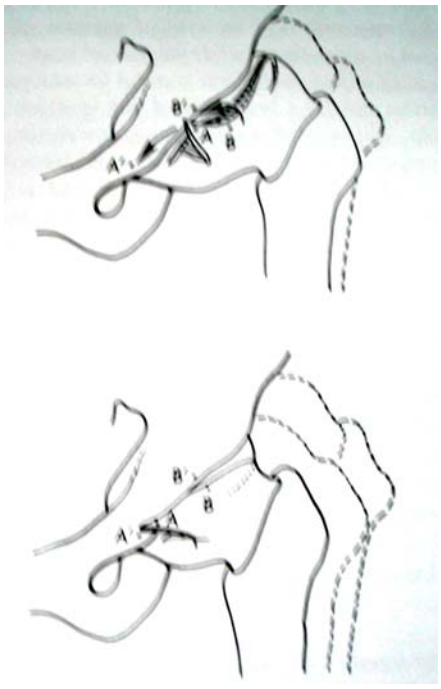
bone osteotomised is calculated in the preoperative radiograph from the superior pole of head of the femur to the superior border of true acetabulum. The femur is fixed with 3.5 mm cortical screws in asian dynamic compression plate.

During the fixation of the femur the valgus position of the upper femer is corrected into varus position. After the open reduction the patella will face medoally an the limb will be in internal rotation. The internal rotation is also corrected during the fixation of the osteotomised femur by derotation.

Capsulorrhaphy

The lax redundant capsule is excised and tightened by capsulorrhaphy by double breasting method.





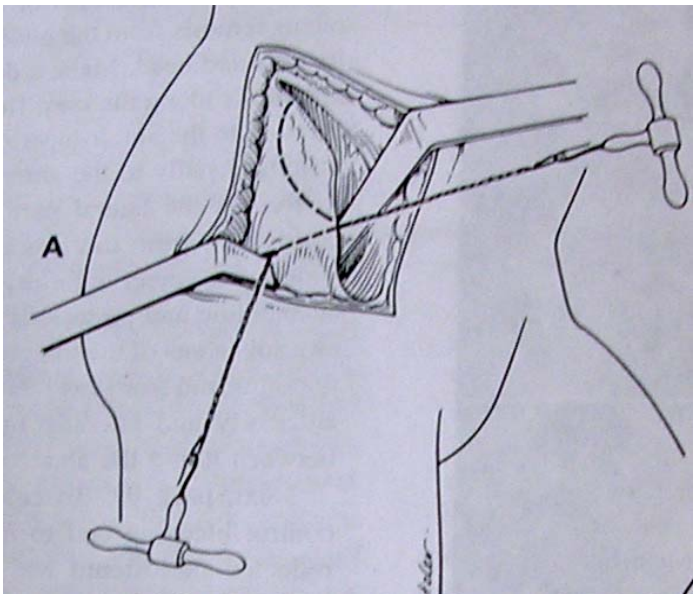
Pelvic Osteotomy

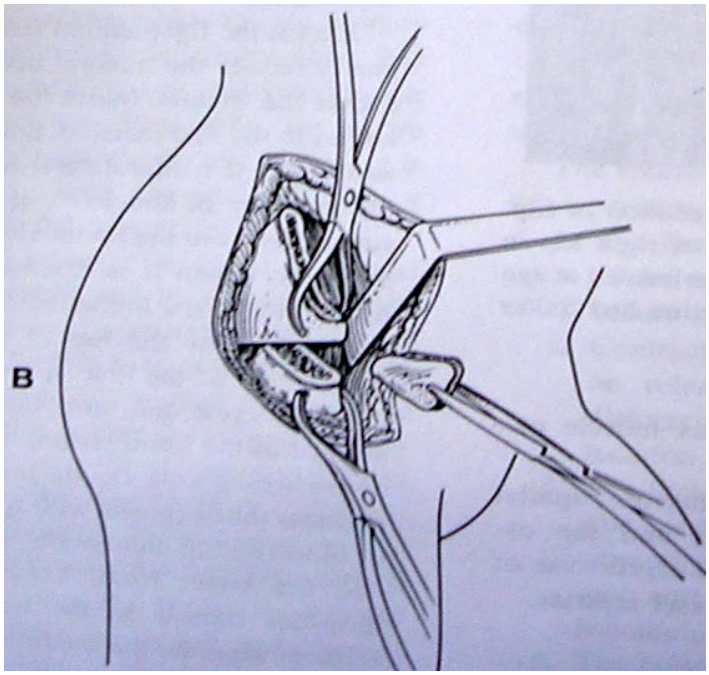
Pelvic osteotomy is done to reorient and reshape the acetabulum for the better containment of the femoral head in the dysplastic acetabulum.

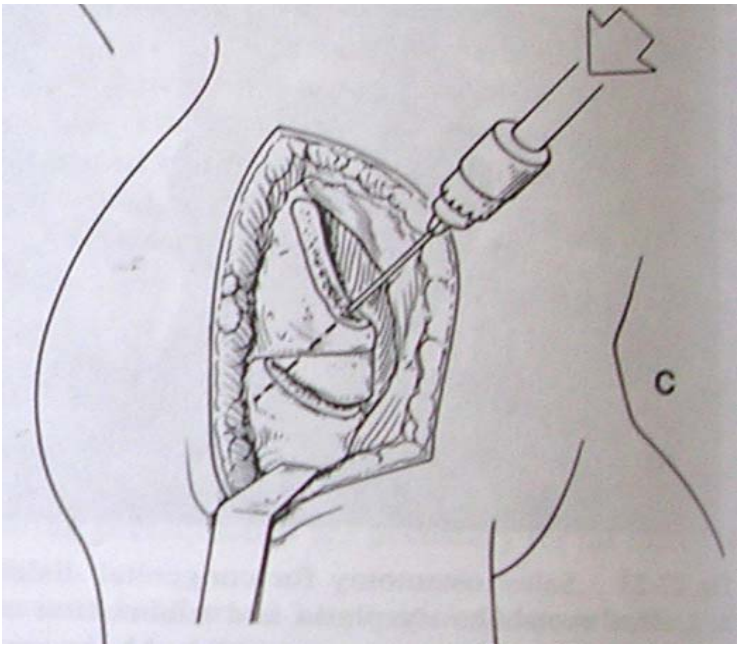
Salter Innominate Osteotomy

Salter innominate osteotomy is made just above the acetebulum running transversely from the anterior superior iliac spine to the greater sciatic notch subperiosteally. The lower fragment is displaced downwards, outwards and forwards. While displacing the lower fragment the pubic symphysis is acting as a hinge. A wedge shaped graft which is harvested from the anterior

part of the iliac crest is inserted into the osteotomy site to maintain the position and fixed with two K-wires.

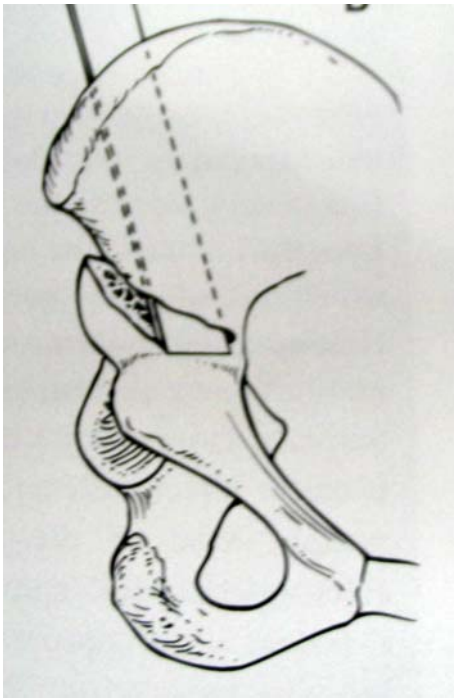


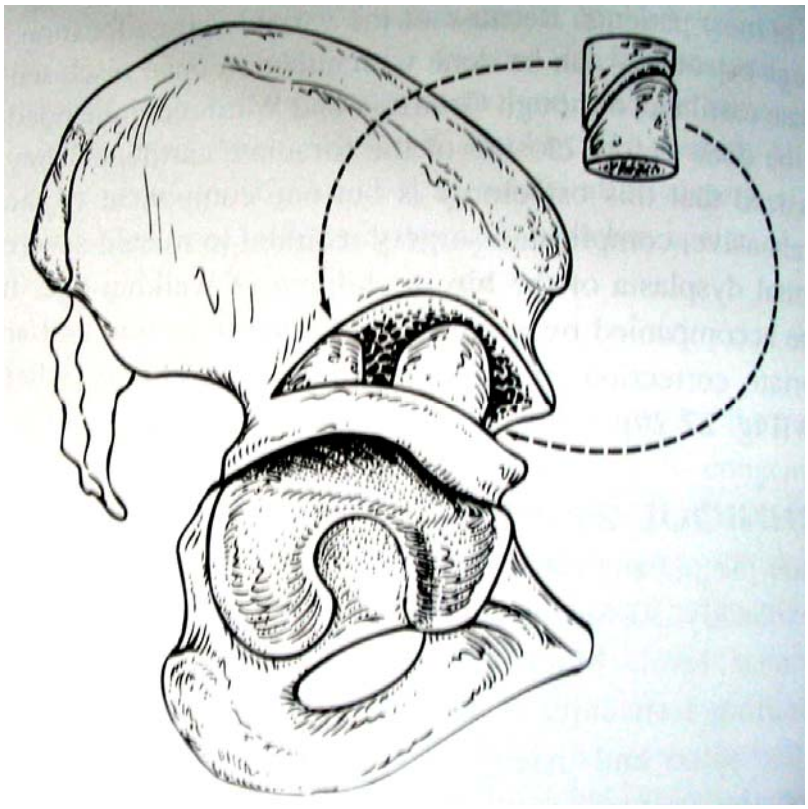




Dega Osteotomy

Dega osteotomy is a transiliac osteotomy for the treatment of acetabular dysplasia in developemental dysplasia of hip. This is a alternative to salter innominate oeteotomy. This incomplete transiliac osteotomy involves osteotomy of the anterior and middle portion of the inner cortex of the ilium. The posterior cortex is intact and acts as a hinge. At the osteotomy site the lower fragment is displaced and resected femur from the femoral shortening is used as a graft.





The following prerequisites are necessary for the success of pelvic osteotomy.

1. The femoral head must be positioned opposite to the level of the acetabulum, this requires the primary femoral shortening.
2. Contracture of the iliopsoas must be relaxed to obtain open reduction of hip joint.
3. The femoral head should be reduced into the depth of the true acetabulum completely and concentrically. This needs excision of the fibro cartilage from the acetabulum.

MATERIALS AND METHODS

In this study we have taken 12 hips in 10 patients, who were operated for neglected developmental dysplasia of hip. This study was conducted in Institute of Child Health and Government General Hospital, Madras Medical College. All the patients under went one stage correction procedure (ie) Klisic procedure which consist of

- Open reduction of dislocated hip joint.
- Primary femoral shortening, varization and derotation
- Capsulorrhaphy
- Pelvic osteotomy namely salter or Dega for acetabular dysplasia

Total number of patients

Sex	Number	Percentage
Female	8	80%
Male	2	20%

There were 8 female and 2 male children with the female preponderance of developmental dysplasia of hip. All the patients

were more than 3 yrs old. The lowest age in 3 yrs and the highest age is 15 yrs. The mean average of the age is 7 yrs. There were 7 left sided hips of 5 right sided hips which include 2 bilateral hips.

Side of the hip

Side of Hip	No	Percentage
Left Side	7	58.33%
Right Side	5	41.76%

Four patients had previous unsuccessful surgical attempts, one patient had bilateral congential talipes equinovarus, another patient had secondary valgus deformity of the knee due to stiff hip. The period of study in from 2003 – 2004. The longest follow – up is 2 yrs 10 months of the shortest follow – up is 1 yr 7 months.

Inclusion Criteria

1. The children, more than 3 yrs old with developmental dysplasia of hip are included in this study.
2. The children who under went previous surgeries for developmental dysplasia of hip are also included in this study.

3. The children with associated deformities like congenital talipus equino varus and secondary valgus deformity of knee due to the stiff hip are also included in this study.

Exclusion Criteria

The children with developmental dysplasia of hip, less than 3 yrs old were excluded from this study.

All the patients were evaluated radiologically and clinically. The pre operative acetabular index is measured.

Pre Operative Radiological Evaluation

No. of Hips	Acetabular index
1	34°
2	40°
3	62°
4	43°
5	42°
6	35°
7	45°
8	38°
9	35°
10	45°
11	43°
12	45°

The average pre operative acetabular index is 42°

RESULT ANALYSIS

All the patients are evaluated clinically and radiologically.

Clinical Evaluation

Post operatively after the period of immobilization (6 – 8 weeks) the patients were evaluated with the following criteria.

- Pain in the hip joint while at rest, standing and walking.
- Stability of the hip.
- Range of movement of the hip joint
- Trendelenburg sign.

Modified MC Kay's Classification

Excellent	Painless stable hip. No limp More than 15° internal rotation Negative trendelenbrug sign
Good	Painless, stable hip, Slight limp Slight decrease on hip rotation Negative tredelenburg sign
Satifactory	Minimum Pain Moderate stiffness Positive tredelenburg sign
Poor	Significant pain, Gross stiffness Positive tredelenburg sign

Results of clinical evaluation by modified mckay's classification

Clinical Result	Number	Percentage
Excellent	3	25%
Good	2	16.67%
Satisfactory	5	41.66%
Poor	2	16.67%

Radiological Evaluation

Post operatively all the patients were evaluated radiologically with Severin's classification. The Serevin classification includes the following criteria

- Deformity of the femoral head
- Deformity of the femoral neck
- Deformity or dysplasia of acetabulum
- Articulation of the femoral head
- Centre edge angle
- Age

Post operative and acetabular index is measured.

Severin's Classification for post operative radiological

Evaluation of developmental dysplasia of hip

Grade	Results	Radiologic Appearance	Centre – Edge angle	Age
Ia	Excellent	Normal	> 19° > 25°	6 - 13 yrs ≥ 14 yrs
Ib	Good	Normal	15°– 19° 20°– 25°	6 – 13 yrs ≥ 14 yrs
II	Good	Moderate deformity f femoral head, femoral neck and acetabulum	15°-19° 20°-25°	6 – 13 yrs ≥ 14 yrs
III	Good	Dysplasia without subluxation	< 15° < 20°	6 – 13 yrs ≥ 14 yrs
IV a	Fair	Moderate subluxation	> 0	
IV b	Fair	Severe subluxation	> 0	
V	Poor	Femoral head articulated with pseudo acetabulum		
VI	Poor	Redislocation of superior part of original acetabulum.		

Radiological Evaluation

Grade	Number	Percentage
I	1	8.33%
II	8	66.67%
III	1	8.33%
VI	2	16.67%
V	-	-
VI	-	-

Post Operative Radiological Evaluation

No. of Hips	Acetabular index
1	28°
2	35°
3	40°
4	33°
5	31°
6	31°
7	33°
8	32°
9	30°
10	35°
11	38°
12	30°

The average post operative acetabular index is 33°

COMPLICATION

Secondary subluxation	-	1
Supra condylar fracture	-	1
Superficial infection	-	1
Lateral Popliteal nerve palsy	-	1

One secondary subluxation of femoral head posterior after salter innominate osteotomy as the posterior wall of the acetabulum is deficient. Supracondylar fracture of femur occurred during mobilization in the post operative period. The superficial infection is treated by antibiotics. The lateral popliteal nerve palsy is due to the complication of correction of the secondary valgus deformity of the knee due to a dislocated hip. This accurse while correcting the deformity with ilizarov fixator. This managed by lateral popliteal nerve release.

DISCUSSION

In our study all the patients with neglected developmental dysplasia of hip were having secondary changes in the soft tissues, bony pelvis and in the upper femur.

Many treatment options here been proposed for developmental dysplasia of hip. Among those are

1. Closed reduction
2. Closed reduction combined with pre operative traction or adductor tenotomy.
3. Open reduction
4. Open reduction combined with either a femoral or pelvic osteotomy.
5. Open reduction combined with femoral and pelvic osteotomy.

In our study all the patients were treated with a one stage correction with open reduction capsulorrhaphy, femoral shortening varization, derotation and pelvic osteotomy like Salter or Dega oesteotomy.

In our study we did not use any pre operative traction. In older children the more rigid contractures of the soft tissues may

prevent reduction or may cause it to be unstable.[8, 11] This tightness also results in major pressure on the capital femoral ossific nucleus if reduction is obtained leads to avascular necrosis of the femoral head.[5]

Femoral shortening allows all of the muscles that cross the osteotomy site to function as if they were lengthened. When it is combined with open reduction, it avoids the prolonged hospitalization, risk of skeletal traction and avascular necrosis.

There have been numerous reports discussing the merits of the more aggressive surgical approach which includes open reduction of the dislocated hip, femoral procedure for relatively long femur and valgus malallignment of the neck and pelvic osteotomy for acetabular dysplasia. In all the reports the results were encouraging.

In our study we have shown 83.33% excellent to satisfactory results clinically and 83.33% excellent to satisfactory to results radiologically which is comparable with other studies.

Galpin et al have reported 75 - 85% satisfactory results radiologically and clinically.[5] Rachid K Haider have reported 97.8% excellent to good results clinically.[18] In this study he is able to show better results because the patients were relatively young age.

Salter and dubos have reported excellent to good results 93.6% rediologically in patients less than 4 yrs. And 56.7% between the age of 4 – 10 yr.

R.R. Rajendra et al have shown 76.9% clinically excellent to good results 69.2% radiologically excellent to good results.[19]

We did not use any pre operative traction pre operatively. The open reduction femoral shortening derotation and varization effectively lengthens the soft tissue across the hip joint and decrease the pressure on the femoral head during and after reduction. This is one of the important causes for the prevention of avascular necrosis.[5,8,11]

In our study early cases were done with salter innominate osteotomy we found there is a chance of secondary subluxation posteriorly after Salter Innominate Osteotomy. The dislocation after Salter Innominate Osteotomy is discussed by Fixen et al.[4] He suggest that the secondary subluxation his due to poorly executed osteotomy, a lax capsulorrhaphy or a excessive fermoral anteversion. During the combined procedure the pelvic osetetomy by Salter method will result in posteriorly deficient acetabulum and the derotation preformed for centering the femoral head increases the rate of secondary subluxation of the hip joint.

In our study we have shown 8.33% secondary subluxation rate that is comparable with 5 to 14.3% subluxation rate in Rachid K Haider study.

In later cases we follow Dega osetetomy for the correction of acetabular dysplasia and good results were obtained with out any secondary subluxation.

The functional out come his better in younger children and those who were not undergone previous surgery. The functional out come is relatively poor in older children and who had previous surgeries.

CONCLUSION

The one stage correction procedure can be safely and effectively performed in neglected developmental dysplasia of hip in patients who were more than three years old. Open reduction for the dislocated hip, femoral shortening, derotation and varization for relatively long femur and valgus malallingement of upper femur and pelvic aesteotomy for acetabular dysplasia can give satisfactory clinical and radiological results. If the procedure is done in relatively younger children the functional out come is satisfactory poor results in older children. This procedure has the advantage of decreasing the need for subsequent surgeries in multistage procedure and eliminating the need for prolonged post operative immobilization. In pelvic osteotomy Salter method has a disadvantage of secondary posterior subluxation of hip because of the posteriorly deficient acetabulum. Dega osteotomy can be formed without that complication for acetabular dysplasia.

ILLUSTRATION OF CASES

Case – I

Name	:	Arul Jothi
Age / Sex	:	3 / F
Diagnosis	:	Developmental dysplasia of hip (L) side.
Procedure	:	Klisic procedure with salter osteotomy

Pre Operative Evaluation

Acetabular Index	:	34°

Post Operative Evaluation

Clinical Result	:	Eccellent
Radiological Result	:	Grade I
Acetabular Index	:	28°

Follow up : 2 Years 7 Months

ILLUSTRATION OF CASES

Case – II

Name	:	Akshayalakshmi
Age / Sex	:	9 / F
Diagnosis	:	Developmental dysplasia of Hip Bilateral
Procedure	:	(Rt) Side – Klisic procedure with Dega Osteotomy (Lt) Side – Klisic procedure with Dega Osteotomy

Pre Operative Evaluation

		(Rt) Side	(Lt) Side
Acetabular Index	:	43°	45°

Post Operative Evaluation

Clinical Result	:	Satisfactory	Satisfactory
Radiological Result	:	Grade I	Grade II
Acetabular Index	:	38°	30°
Follow up	:	Year	Months
		(Rt) One year	Nine Month

(Lt) One year Seven Month

ILLUSTRATION OF CASES

Case – III

Name	:	Ammu
Age / Sex	:	11 / F
Diagnosis	:	Developmental dysplasia of hip Right side operated previously
Procedure	:	Klisic procedure with Salter Osteotomy

Pre Operative Evaluation

Acetabular Index	:	42°

Post Operative Evaluation

Clinical Result	:	Poor
Radiological Result	:	Grade II
Acetabular Index	:	31°

Follow up : 2 Years 6 Months

ILLUSTRATION OF CASES

Case – IV

Name	:	Kathirmani
Age / Sex	:	12 / M
Diagnosis	:	Developmental dysplasia with Dega Osteotomy
Procedure	:	Klisic procedure with Dega Osteotomy

Pre Operative Evaluation

Acetabular Index	:	62°

Post Operative Evaluation

Clinical Result	:	Satisfactory
Radiological Result	:	Grade III
Acetabular Index	:	40°
Follow up	:	2 Years 9 Months

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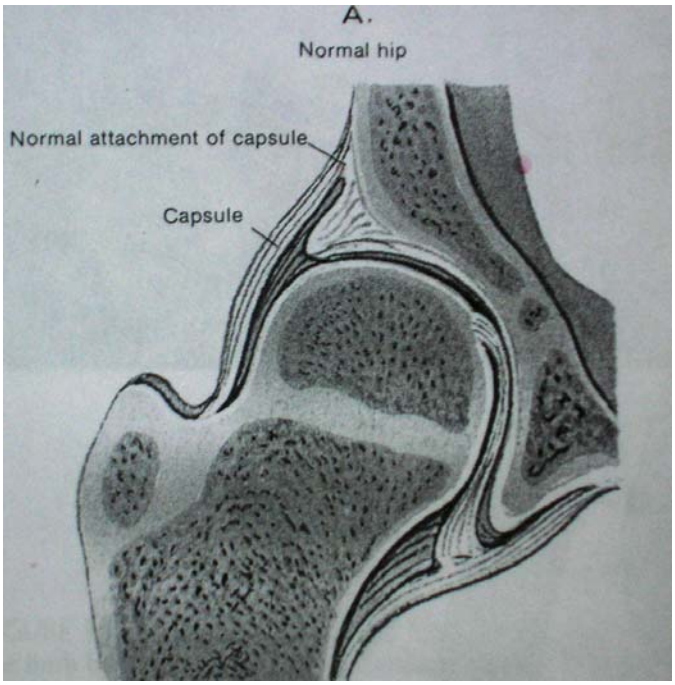
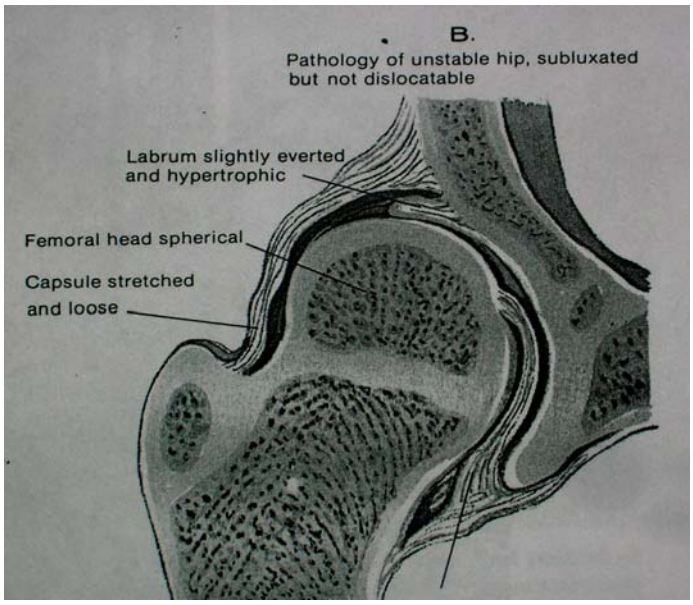
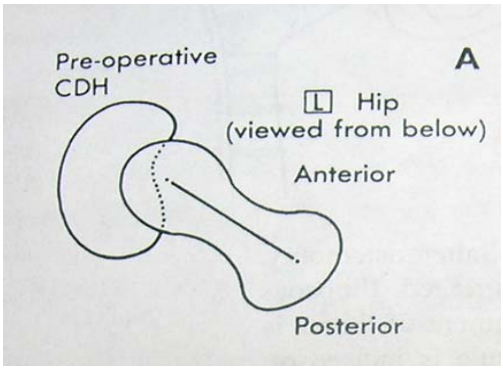
Normal Hip



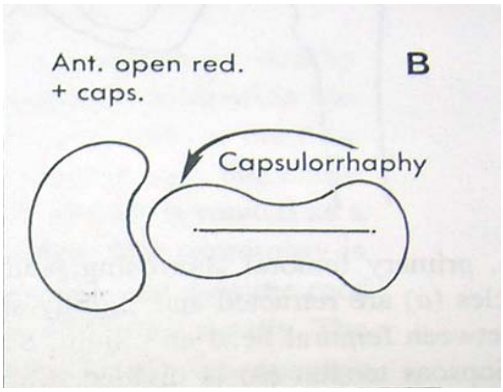
DDH Hip



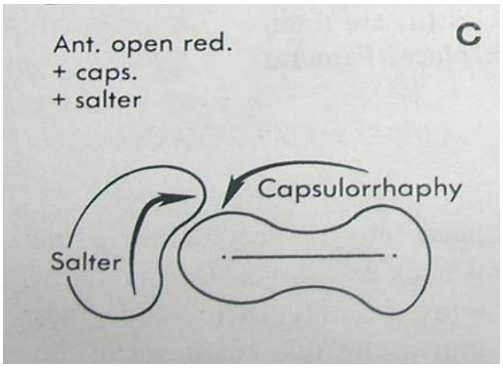
Posterior Subluxation of femoral head after Salter Osteotomy



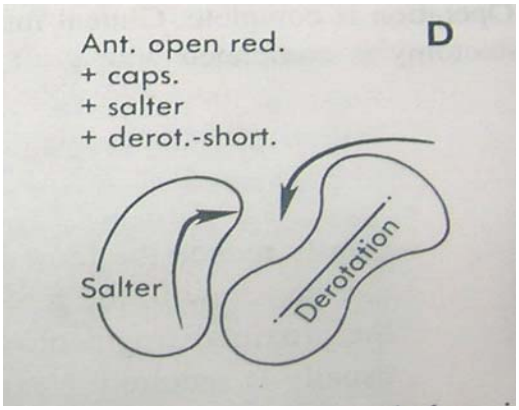
Position of femoral head and acetabulum in DDH.



Position of femoral head after capsularrhaphy.



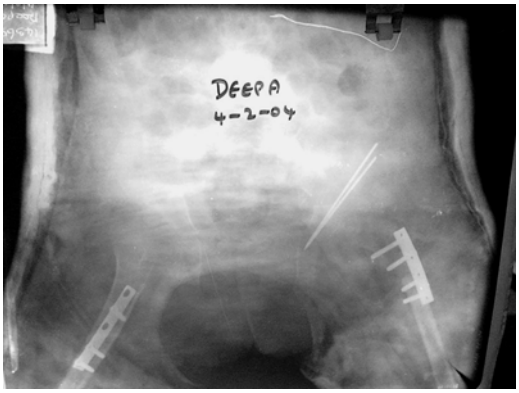
Position of femoral head after Salter Osteotomy.



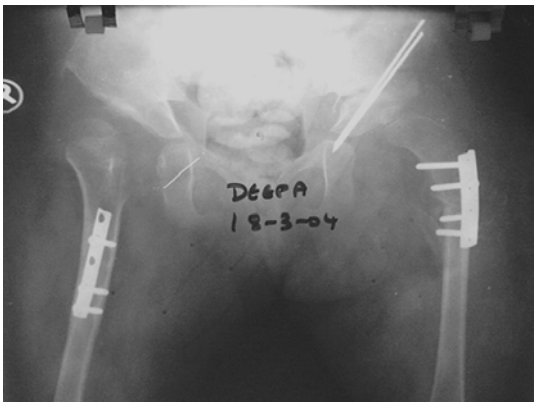
Position of femoral head after Salter Osteotomy and derotation

Case illustration of posterior subluxation after Salter innominate Osteotomy

A case of bilateral DDH right side operated

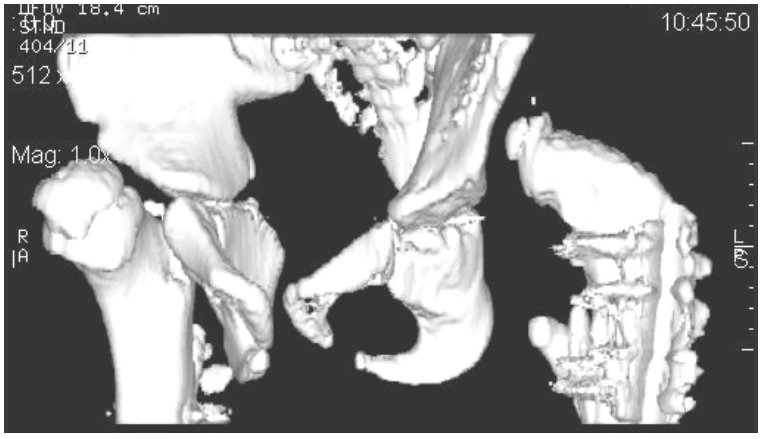


Klisic procedure with Salter Osteotomy done on left side



Posterior subluxation of the femoral head after Salter Osteotomy

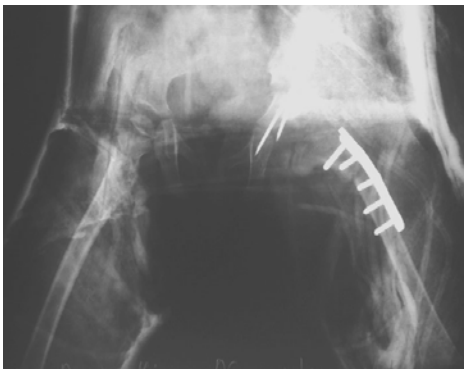
The 3D reconstruction CT showing posteriorly subluxated hip after salter osteotomy and Posteriorly deficient acetabulum



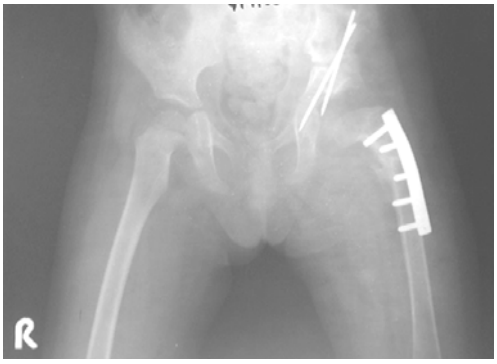
CASE I

Pre op X-ray

Immediate post op X-ray



Post op X – ray



After implant removal

Adduction

Abduction

CASE I

External Rotation

Internal Rotation

Standing

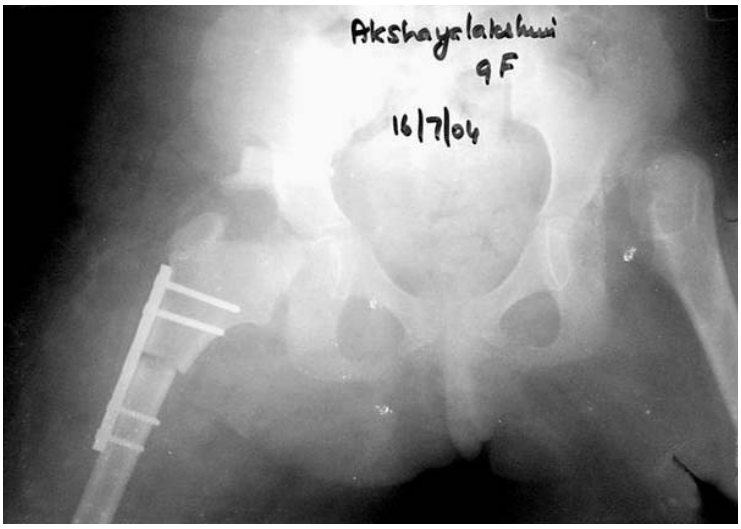
Extension

Flexion

CASE II

Pre op – Bilateral DDH

After right side correction



After left side correction

After bilateral correction

CASE II

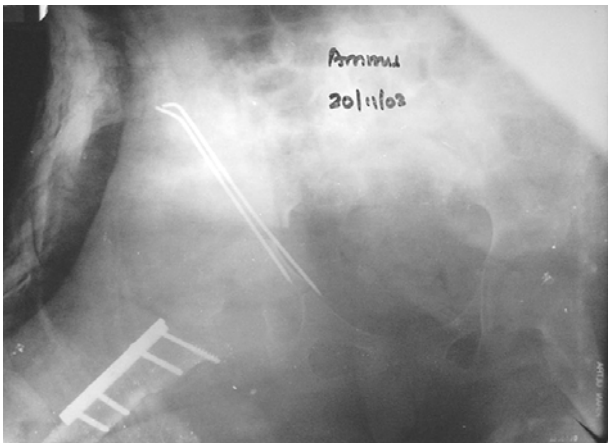
Range of Movements in Right hip

Range of Movements in Left hip

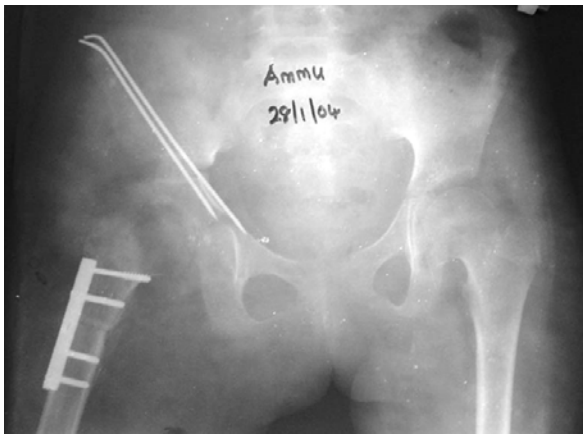
CASE III

Pre op X - ray

Immediate post op X-ray



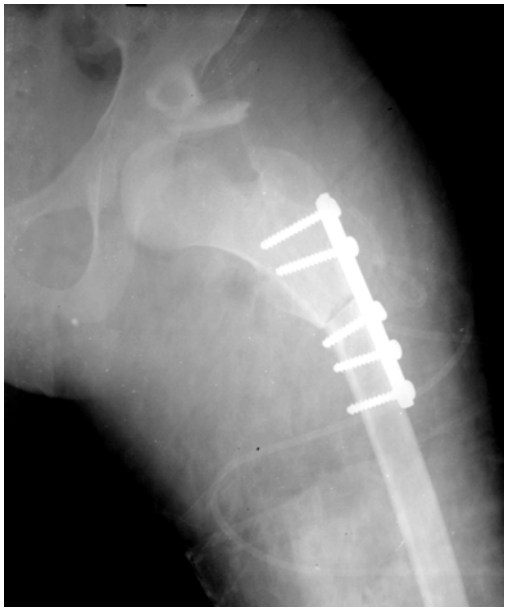
Post of X-ray (after 2 months)



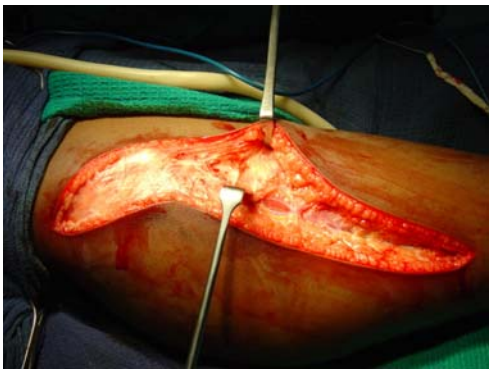
CASE IV

Pre op X-ray

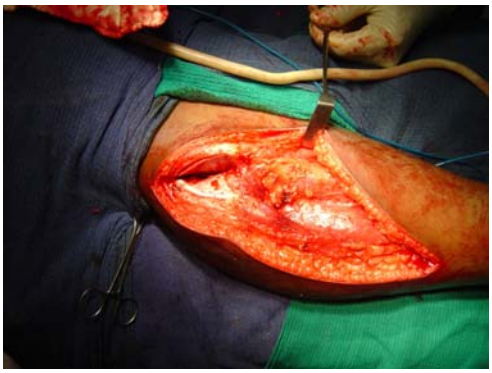
Post op X-ray



Klisic Procedure

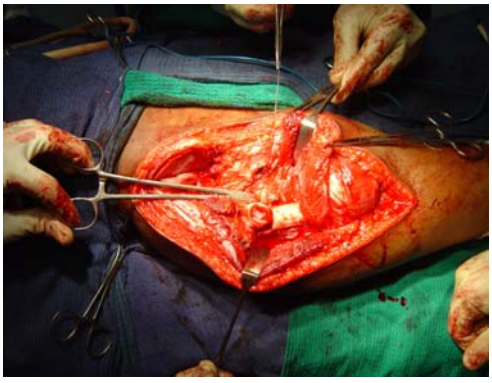


Insicion for Klisic Procedure



Superficial Plane between sartorius and tensor fascia Lata

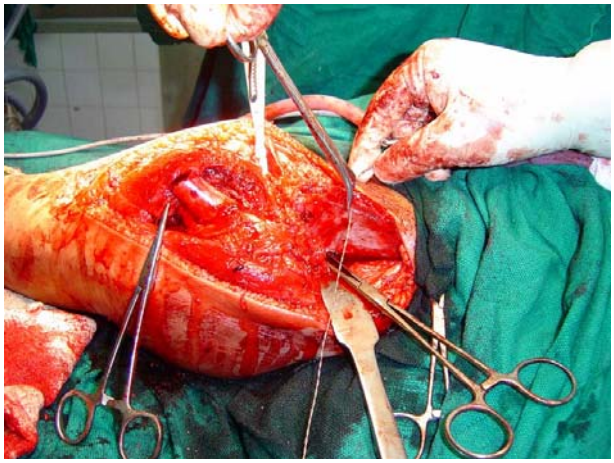
Exposure of femoral shaft



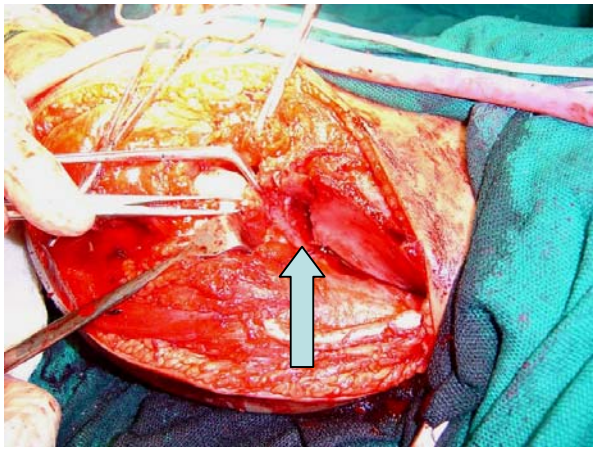
Femoral shortening

Salter Innominate Osteotomy

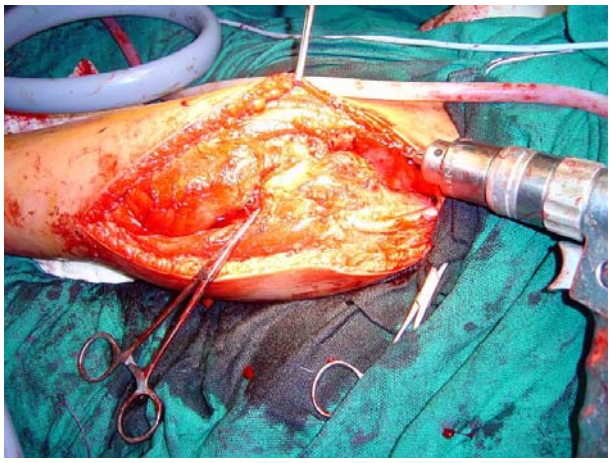
Bone graft harvested from anterior part of iliac crest



Bone graft was kept in the complete trans iliac osteotomy site

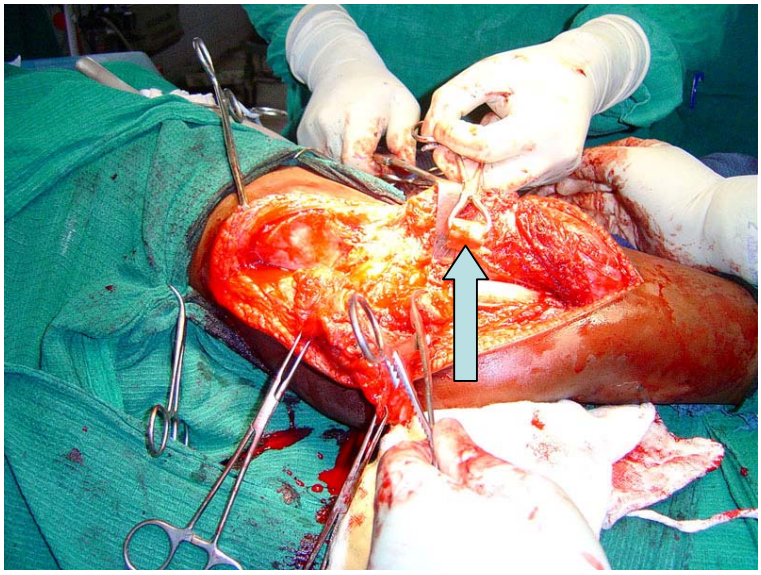


Bone graft fixed with K – wires

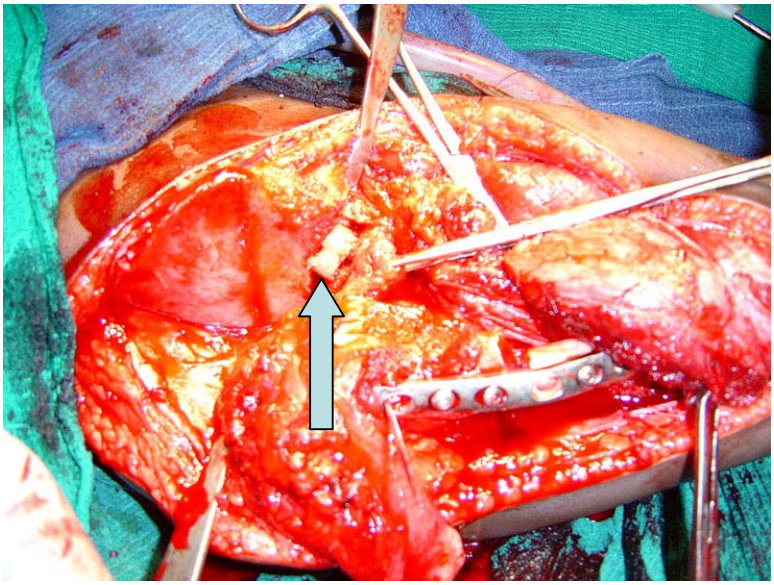


Dega Osteotomy

Osteotomised Femur taken as the bone graft



Bone graft kept in the incomplete trans iliac osteotomy site



MASTER CHART

S.No.	Name	Age / Sex	Diagnosis	Previous surgery	Pre operative		Surgery		Post Operative		Functional Result	Radiological Result	Follow up	
					Neck shaft angle	Acetabular Index	Procedure	Pelvic osteotomy	Neck shaft angle	Acetabular Index		Grade	Year	Month
1	Sushimitha	7 / F	DDH Rt	Operated	140°	40°	Klisic	Salter	130°	35°	Poor	II	2	10
2	Kathirmani	12 / M	DDH Lt	-	143°	62°	Klisic	Dega	128°	40°	Satisfactory	III	2	9
3	Pushpavalli	8 / F	DDH Lt	-	141°	43°	Klisic	Salter	125°	33°	Excellent	II	2	8
4	Arul jothi	3 / F	DDH Lt	Operated	110°	34°	Klisic	Salter	96°	28°	Excellent	I	2	7
5	Ammu	11 / F	DDH Rt	-	128°	42°	Klisic	Salter	121°	31°	Poor	II	2	6
6	Deepa	5 / F	DDH Rt	Operated	125°	35°	Klisic	Dega	120°	31°	Good	IV	2	3
			DDH Lt	-	145°	45°	Klisic	Salter	120°	33°	Satisfactory	II	2	6
7	Krishnakumari	7 / F	DDH Lt	-	141°	38°	Klisic	Dega	125°	32°	Good	II	1	8
8	Kala	4 / F	DDH Rt	Operated	110°	35°	Klisic	Dega	91°	30°	Satisfactory	IV	1	9
9	Arunkumar	4 / M	DDH Lt	-	135°	45°	Klisic	Salter	121°	35°	Excellent	II	1	10
10	Akshayalakshmi	9 / F	DDH Rt	-	140°	43°	Klisic	Dega	105°	38°	Satisfactory	II	1	9
			DDH Lt	-	145°	45°	Klisic	Dega	125°	30°	Satisfactory	II	1	7